

## **Bergen South: The Americanization of the Meteorology Profession in Latin America during World War II**

Gregory T. Cushman  
University of Kansas, Department of History,  
gcushman@ku.edu

### **1 Introduction**

World War II represented a watershed for the meteorological profession, both in terms of its geographical expansion and the multiplication of its membership.<sup>1</sup> The war provided enterprising scientists with the opportunity to establish new centers of action for teaching and research. Not least among these acts was the recruitment of Jacob Bjerknes to form a new meteorology program at the University of California, Los Angeles (UCLA). His arrival in North America culminated a decade during which scientists trained by the “Scandinavian school” founded in the late 1910s in Bergen, Norway, successfully colonized practically all of the academic centers for meteorology in the United States and Canada.<sup>2</sup>

Meteorology also became embroiled in the North-South politics of war-time. The dramatic international expansion of commercial aviation and radio during the 1930s led South American meteorologists to seek to break down the barriers dividing Latin American meteorology along national lines. They did not look initially to the United States for leadership. Beginning in 1940, meteorologists based in the United States tried to hijack this Pan-American movement to bolster “hemispheric defense.” Carl-Gustaf Rossby, the entrepreneurial leader of the Bergen school in the Western Hemisphere, masterminded a plan to exchange expertise and train dozens of southern scientists in the United States. Though encoded in the language of international scientific cooperation, the Inter-American Institute of Meteorology that evolved from Rossby’s plan had a belligerent intent: to eliminate German influence in South American aviation. It also had a quasi-colonialist intent: to extend the Bergen school program to Latin America. Of course, this project would never have succeeded if it had not also served the developmental interests of Latin American technocrats.

This case tangibly shows how scientific internationalism served a variety of empire builders. Scientific internationalism in meteorology during this

---

<sup>1</sup> Nebeker (1995), ch. 9; Petterssen (2001).

<sup>2</sup> Friedman (1989).

era furthered the development of “national science” in the Americas in dramatic fashion. It did even more to extend the United States’ military, commercial, and cultural influence in the Western Hemisphere just before the Cold War. These “science dynamics” reveal the crucial importance of the “moving metropolis” and cultural imperialism to post-colonial science.<sup>3</sup>

## 2 The Colonization of North American Meteorology

In July 1939, Jacob Bjerknæs and his wife Hedvig left Norway for an extended tour of meteorological institutions in Canada and the United States. It is significant that he went to Canada first. Bjerknæs spent the month of August giving lectures at the Canadian Meteorological Office in Toronto. This series culminated with an all-day seminar on extra-tropical cyclone development that served as a centerpiece for a joint international meeting of the Royal Meteorological Society and American Meteorological Society. This meeting was organized by William Thomson, a Canadian disciple of the Bergen school. In 1933, with Bjerknæs’s help, Thomson had established Canada’s first advanced meteorological training program at the University of Toronto to serve the growing needs of Trans-Canada Airlines. By 1939, 34 of the 51 professional meteorologists in Canada had been trained by Thomson’s program. At this meeting, Canadian meteorologists formally declared their intent to establish an autonomous Canadian branch of the Royal Meteorological Society. A formidable line-up of Bergen school meteorologists witnessed this act: Bjerknæs, Carl-Gustaf Rossby, Sverre Pettersen, Horace Byers, Halvor Solberg, the aging V. W. Ekman, and a powerful U.S. disciple, Francis W. Reichelderfer, the new head of the U.S. Weather Bureau. Canada’s embrace of the “Norwegian school” during the 1930s helped it to achieve scientific autonomy from both Great Britain and the Colossus to the South. All this happened only a couple days before the outbreak of World War II on 1 September 1939.<sup>4</sup>

As the war intensified, Rossby worked furiously to convince Bjerknæs to establish a meteorology training program in California. Negotiations were well underway weeks before Germany invaded Norway on 9 April 1940 and ended its reign as headquarters of the Bergen school. The presence of an old friend from Norway, Harald Sverdrup—now the director of the

<sup>3</sup> MacLeod (1982, 2000).

<sup>4</sup> A fully independent Canadian Meteorological Society was formed on 1 Jan. 1967. The proceedings of this meeting were printed in Toronto and distributed as the *Quarterly Journal of the Royal Meteorological Society*, 66, supplement (1940). Eliassen (n.d.); Doty (1977); Joint Meeting (1939); Thomas (1994); Pettersen (2001), p. 68.

nearby Scripps Institution Oceanography (SIO)—ultimately led Bjerknes to settle down at UCLA. He delayed signing a contract, however, until he and Rossby had negotiated the hire of yet another Bergen-trained meteorologist, Jørgen Holmboe, from MIT.<sup>5</sup> Los Angeles's status as center of the world airplane industry provided an additional attraction.<sup>6</sup>

This transfer of the Bergen school's headquarters made an enormous difference in setting Bjerknes's future research agenda. But in the short term, these Scandinavians had little time for research, as they implemented a massive program for "Education and Training in Meteorology for the Armed Forces." From 1940-1945, UCLA and SIO together trained over 1,400 scientists in the "advanced study" of meteorology and physical oceanography. Only a few hundred of the 6,200 meteorologists trained during the war in the United States received their education at an institution that was not dominated by adherents of the Bergen school. Through such efforts, Rossby's long-standing plans for the Bergen school to colonize North American meteorology became a reality.<sup>7</sup>

### 3 The Struggle for Latin American Airways

The westward shift of the "Norwegian School" to the shore of the Pacific Ocean changed its geographical perspective. During the early months of the war, these Scandinavian expatriates began shifting their gaze south to Latin America.

A major international scientific event helped inspire this shift. In May 1940, a vast contingent of Latin American scientists and diplomats descended on Washington, DC, for the Eighth [Pan] American Scientific Congress.<sup>8</sup> President Franklin Delano Roosevelt set the tone for this event with an important restatement of official U.S. policy regarding hemispheric unity: "The annihilation of time and space" by "planes and bombs" meant that "every acre—every hectare—of the Americas" was in danger. "I am a pacifist," Roosevelt declared, in reference to his Good Neighbor Policy rejecting U.S. military intervention and embracing bilateral collaboration in

<sup>5</sup> Rossby (7 Mar. 1940); Varney (16 Jan. 1940); Knudson (16 Jan. 1940); Holmboe (24 June 1940, 10 July 1940); Bjerknes (2 July 1940, 22 Aug. 1940); Sproul (Aug. 1940); Day (1999).

<sup>6</sup> Gilluly, et al. (27 Mar. 1940). On the rise of Southern California's aviation industry during the 1930s, see Lotchin (1992), ch. 2; Bilstein (2001), p. 55-62; Pattillo (1998), ch. 5-6.

<sup>7</sup> MIT, UCLA, NYU, the University of Chicago, and the California Institute of Technology operated wartime training programs; Cal Tech was the only institution not dominated by Bergen School scientists. Bjerknes (1 Feb. 1946); Kaplan (24 Feb. 1942); Scripps Institution of Oceanography [1945]; Lewis (1994), p. 74-76; Pettersen (2001), p. 82; Fuller (1990), p. 30.

<sup>8</sup> Eighth American Scientific Congress (1941), vol. 1, p. 9-10.

Latin America. "You, my fellow citizens of twenty-one American Republics are pacifists. But I believe . . . you and I . . . will act together to protect and defend by every means our science, our culture, our freedom and our civilization." A parade of Latin American scientists and diplomats echoed Roosevelt's "Messianic words" affirming the "duty of science" to make "Pan Americanism . . . a living and tangible thing."<sup>9</sup>

About 125 people attended the meteorological session of the Congress. The Chief of the Mexican Meteorological Service impressed everyone with his report detailing Mexico's modern weather network, much of it modeled on the U.S. Weather Bureau and installed by Pan American Airways. This event inspired tangible internationalist sentiment among North American meteorologists. The American Meteorological Society made sure this session meeting had a broad impact on the profession by distributing the eventual 36 articles that appeared in its published proceedings as a supplement to the AMS *Bulletin*. At the urging of the head of the Argentine Meteorological Observatory Alfredo Galmarini, an outspoken advocate of "continental meteorology," the AMS Council took a further step: In the summer of 1941, it decided the "Society should fulfill its *true hemispherical nature* by publishing parts of its BULLETIN in Spanish as well as English" in order to encourage "greater interchange of ideas and closer personal relations between Spanish, Portuguese and English speaking Americans."<sup>10</sup>

A close reading of these materials reveals the extent to which Latin American meteorologists embraced international collaboration *before* U.S. meteorologists suddenly became Pan Americanists. Meteorologists from the Southern Cone and Brazil led the way in these endeavors. Between 1935 and 1939, they organized three Latin American meteorological congresses, a regional commission of the International Meteorological Organization (IMO), and an international meteorological review published in Uruguay. The establishment of commercial air service and radio transmissions linking these countries provided the main motivation for these endeavors.<sup>11</sup> The Observatorio del Salto in Santiago de Chile nurtured scientific ties that spanned not only South America but the entire Pacific. It took part in a project with New Zealand and Argentina to determine the average trajectories

<sup>9</sup> Eighth American Scientific Congress (1941), vol. 1, p. 13, 15-16, 24, 31, 35; see also Green (1971).

<sup>10</sup> This bilingual section did not appear until Jan. 1943. Eighth American Scientific Congress (1941), vol. 1, p. 153-154; Brooks (1941, 1942); Bowie (1942), emphasis added; Galmarini (1943).

<sup>11</sup> Galmarini (1943); Morandi (1943).

of depressions and anticyclones in the South Pacific. Chilean meteorologists showed a particular interest in the correlation between abnormal precipitation and what we now call the Southern Oscillation; to this end, they carefully collected daily reports transmitted by shortwave from Manila, Hanoi, and Batavia (now Jakarta). Ecuadorian scientists were similarly engaged in projects to relate solar radiation, abnormal precipitation patterns, and variations in the strength of the “‘El Niño’ countercurrent” off the coast of Ecuador.<sup>12</sup> From today’s perspective, these look like promising avenues for research, but at the time, this preoccupation with weather cycles and solar forcing highlighted the peripheral status of Latin American meteorology. Years of statistical investigation—and the Bergen school’s emphasis on air mass analysis—had led all but a few northern meteorologists to abandon their one-time mania for weather cycles by the late 1930s.<sup>13</sup>

All this lofty rhetoric concerning peaceful scientific collaboration in the Western Hemisphere obscured the main motivation for this Pan American trend in meteorology. Since the days of the Weimar Republic, business interests from Germany, the United States, and other northern countries had been engaged in a non-shooting war to dominate the commercial airways of Latin America and the Caribbean. Contrary to the stereotype of technological backwardness, Latin Americans have often been among the earliest adopters of new technologies and scientific techniques: In December 1919, a group of *Auslandsdeutsche* and Colombian investors established the Sociedad Colombo-Alemana de Transportes Aéreos (SCADTA), one of the world’s first successful commercial airlines. But as with railroads, Latin American airlines became a potent instrument of northern business imperialism.<sup>14</sup>

With so much of the world closed off by the Versailles Treaty, Germans rushed to take advantage of business opportunities in South America, the “Last Free Continent” open to German expansionism. Junkers-Flugzeugwerke AG, the supplier of SCADTA’s first planes, established several of the earliest commercial airlines in South America to serve as a market for its aircraft. This entailed, not only the use of Junkers aircraft and parts, but also German technicians, pilots, radio operators, loans from German banks—and sometimes German-trained meteorologists. By the

<sup>12</sup> Eighth American Scientific Congress (1941), vol. 7, p. 395-404, 413-417, 421-422.

<sup>13</sup> Nebeker (1995), p. 94-99.

<sup>14</sup> Rinke (1995), p. 160-163; Burden (1943), p. 11-12. On business imperialism, see Topik and Wells (1998); Rinke (1996); Platt (1977).

late 1920s, German airlines utterly dominated commercial air travel in the region, despite intense international competition. Germans also got the jump in providing all-air trans-Atlantic passenger service with seasonal zeppelin flights beginning in May 1930. Leipzig professor Ludwig Weickmann, a close associate of the Bjerknes family, worked as the principal forecaster on the *Graf Zeppelin's* inaugural trip to South America.<sup>15</sup>

As with so many aspects of international affairs, the United States was late to join this struggle, but it made a decisive impact once it did. Through a lucrative indirect subsidy, the U.S. Postal Service ensured that a single U.S. corporation, Pan American Airways, acquired a virtual monopoly over North-South air service in the Americas. Pan American used this advantage and the crisis that followed the Great Crash of 1929 to purchase several local airways in Latin America, including 84 percent of its German-owned competitor SCADTA. By 1934, Pan American Airways was bigger than all its competitors combined. Except where limited by contract or law, Pan American Airways tended to employ U.S. pilots, aircraft, and meteorologists.<sup>16</sup>

But even rabid nationalists in Latin America had good reasons for supporting this neocolonial trend. Better transportation entailed increased tourism, trade, and greater local incomes (even if a tiny elite got the lion's share). Like railroads for previous generations, airplanes represented the cutting edge of modern technology and potent symbols of progress. Thus, Brazil's nationalist president Getúlio Vargas saw fit to spend US\$1 million to build a luxurious terminal outside Rio to receive German dirigibles in 1936, only to close it soon after the 1937 *Hindenburg* disaster. Economic nationalists made sure these flying technological enclaves were not isolated from their host societies. Mexico, Brazil, and Chile led a trend requiring foreign airlines to employ local ground crews and administrators, train citizen pilots and mechanics, and maintain a level of national ownership. Even more than railroads, airplanes held enormous strategic importance for Latin America's rulers, since they provided a rapid, effective means to integrate national territory under a single, centralized power, especially in the rugged Andes. To this end, in the late 1920s, the Peruvian and Chilean armies were the first to establish regularly scheduled airlines to serve regions either too remote or too important to leave to private companies. Argentina

<sup>15</sup> Rinke (1995, 1996); Burden (1943), p. 10-11, 16-18, 19-20, tables 6, 15, 53, maps 4, 6-7; Georgii and Seilkopf (1926); Flohn (1962).

<sup>16</sup> Burden (1943), p. 22-32, 56-59, 115-118; Nunn (1983), p. 177-179; Rinke (1996), vol. 2, p. 724-739.

and Venezuela took advantage of the Great Depression by taking control of routes and equipment abandoned by the defunct French *Compagnie Générale Aéropostale*.<sup>17</sup>

During the late 1930s, northern aircraft manufacturers competed to equip these national airlines—and closely associated military air forces. As an explicit part of National Socialist foreign policy, Junkers supplied JU-52 tri-motors to Latin American airlines at a lower price and much better re-payment terms than its Los Angeles-based competitors. Lufthansa's *Condor-Syndikat*, the third-largest airline in Latin America, offered convenient servicing at its shops in Rio and Buenos Aires. California airplane manufacturers cared deeply about these trends: the export trade was the most profitable sector of U.S. aircraft production. In fact, aeronautical exports saved the aircraft industries of both Germany and the United States during the darkest days of the Great Depression. By the end of 1940, the U.S. aeronautical industry had practically won this commercial war: a clear majority of the multi-engine transport airplanes in service in Latin America, as well as the pilots and airlines operating them, came from the United States.<sup>18</sup>

Meanwhile, a significant segment of the professional officer corps in several South American countries had become fed up with the virtual monopoly over the provision of arms and expertise France established after World War I. Some older officers fondly remembered the days when German military advisors converted Chile into the "Prussia of South America." Others looked to the United States for aid. This shift started with airplanes. Peru and Brazil both contracted U.S. air missions during the late 1930s, leading to vocal protests from Chile and Argentina. Any change threatened the balance of power between these long-time enemies. In 1938, after Germany recalled its aviation advisors from Argentina, the U.S. Army made a secret arrangement to re-staff Argentina's flight-training program, but Brazil found out and fired off a salvo of diplomatic threats. On the eve of World War II, Roosevelt's vision of hemispheric unity was nothing but a castle in the air. South America's militaries not only were mutual enemies, they were internally fractured into pro-French, German, and U.S. cliques.<sup>19</sup>

<sup>17</sup> Burden (1943), p. 17-18, 29-32, 49-54.

<sup>18</sup> Burden (1943), p. 39-44, 47-48, 95-97, map 7; Pattillo (1998), p. 94-97, 100; Wagner (1996), p. 348.

<sup>19</sup> Nunn (1983), p. 177-182, 187-188, 203-204, 207, 210, 216-217; Rinke (1996), ch. 8.

South American meteorologists did what they could to resolve these conflicts, driven both by the practical need to extend their observation networks beyond national borders and by the high-minded belief that scientific internationalism would promote regional peace and harmony. In December 1938, the Argentine Meteorological Service sent its master barometer (Wild-Fuess no. 100751) to Berlin for calibration with official instruments kept by the Reichsamt für Wetterdienst. This made perfect sense considering Argentina's close ties to Europe and the number of Germans who worked for the Argentine Meteorological Service.<sup>20</sup> The regional meteorological conference held at Montevideo the following February resolved to calibrate all weather service barometers in South America with this Argentine instrument, except those in Colombia and Venezuela (which had faster transportation links to the United States than to their southern neighbors). In 1940, Peru contracted Alfredo Galmarini, the director of the Argentine Meteorological Service, to reorganize its national meteorological network. South American meteorologists did not naturally look to the United States for scientific leadership before World War II.<sup>21</sup>

#### 4 The Americanization of Latin American Meteorology

The professional architecture of aviation and meteorology in Latin America and the Caribbean changed rapidly in the months following the 1940 American Scientific Congress. In June 1940, Nelson Rockefeller—soon to be Coordinator for Inter-American Affairs—published his influential report calling for the “economic defense” of the Americas. A key part of this strategy involved the deployment of technical experts to Latin America, including William Burden's appointment to investigate the “Nazi imperialist drive to dominate South American airlines.”<sup>22</sup> Long before Burden published his exhaustive report, the U.S. Department of State began putting intense pressure on Latin American airlines to fire their German employees. Meanwhile, the United States used its power over fuel supplies to enforce a

<sup>20</sup> For example, Walter Knoche, a Berlin native and product of the University of Berlin's geography program was Argentina's chief climatologist, and had earlier served as head of Chile's Meteorological and Geophysical Institute and founder of its short-lived Easter Island meteorological observatory; Galmarini (1945).

<sup>21</sup> Eighth American Scientific Congress (1941), vol. 7, p. 331-335; Gran enciclopedia argentina (1957), s.v. Galmarini, Alfredo G.

<sup>22</sup> Green (1971), p. 47-48; Pike (1995), p. 251-254; Burden (1943), p. xxi-xxii. Despite his anti-German bias, Burden used a remarkable range of oral histories, published reports, and unpublished data to produce an indispensable expert account of the early development of Latin American airlines.

fuel embargo that grounded German-owned airlines in the region. Pan American welcomed this chance to expand its network, while Ecuador, Peru, Bolivia, and Brazil eventually seized German property to bolster their national airlines. In January 1941, Rockefeller launched an all-out campaign against Germans, Italians, and Japanese nationals working in Latin America. Such campaigns ultimately led to the deportation of around 600 Germans—and thousands of Japanese-Latin Americans—to U.S. prison camps. In April 1941, the U.S. government established an US\$8 million program to resupply South American airlines with U.S. hardware. By 1943, all 29 JU-52s in operation in December 1940 had been replaced by Los Angeles-built aircraft. These actions quickly converted Southern California into the technological metropole for South America aviation.<sup>23</sup>

In some cases, the United States took a strong-armed approach toward Latin American meteorology. Less than a week after the United States entered the war, with Ecuadorian permission, the U.S. Army landed a force on Isla Baltra in the Galápagos archipelago in order to build an airport to patrol the southern approach to the Panama Canal. In August 1942, the Sixth Weather Squadron established a first-order observatory at the Galápagos airport. The Army Air Force also took over meteorological services on the “southern route” connecting Miami to West Africa via Cuba, the Dominican Republic, and Brazil, though in most cases, military forecasters simply replaced U.S. civilians who worked for Pan American Airways.<sup>24</sup>

But for the most part, meteorologists in the United States—especially Scandinavian meteorologists—relied on international cooperation to expand their influence “in neighboring countries” to the south.<sup>25</sup> Their skillful use of scientific internationalism in this context enabled them, not only to cross persistent barriers to U.S. influence, but also to unite Latin American enemies in a common cause. In the process, dozens of Latin Americans were exposed to the scientific tenets of the Bergen school.

In preparation for such a turn of events, C. G. Rossby instructed Jacob Bjerknes to incorporate synoptic analysis of South American weather maps into UCLA’s initial meteorological training curriculum. Between his first two semesters at UCLA, after toying with the idea of visiting Cuba,

---

23. Burden (1943), p. 45, 51, 69-77, 128, 145-146; Green (1971), 56-58; Friedman (2003); Weglyn (1976), p. 56-66, 287 n. 14.

24. Fuller (1990), p. 64, 191-192; Latorre (1999).

25. Reichelderfer (1943), p. 105.

Bjerknes headed to Mexico City in order to teach air mass analysis to the Mexican Meteorological Service. The U.S. Weather Bureau, meanwhile, sent R. Hanson Weightman to South America. His tour influenced Argentina—the only Latin American state that remained completely aloof from the wartime alliance—to establish a local, 30-member chapter of the AMS. In 1942, the New Orleans and Washington offices of the U.S. Weather Bureau put together a six-month training program for ten circum-Caribbean students focused on hurricane prediction and radiosonde technique.<sup>26</sup>

In the fall of 1941, Rossby hatched a plan to extend these activities. Rossby was not interested merely in preventing “Nazi sabotage” or acting as a “Good Neighbor.” He believed knowledge of regions “far removed” from the United States—even “true equatorial air”—might improve North American forecasts, especially with regard to climate anomalies. He proposed an extended tour of the “principal meteorological centers” of Mexico and South America by two “recognized meteorologists” with “tact and sympathy for the Latin American temperament.” He volunteered himself and Bjerknes, two Scandinavian immigrants without clear national loyalties in the “struggle for airways in Latin America.” Rossby also proposed an exchange program that would have sent ten young U.S. meteorologists to Latin America to equip five new observatories for upper-atmospheric observations, and ten young South American nationals to the United States for advanced meteorological training. He specifically recommended Chicago, UCLA, and NYU. The specifics of this proposal clearly reveal Rossby’s underlying motive: to expand the influence of the Bergen school to a vast new region.<sup>27</sup>

Rossby’s plan evolved into an elaborate training program that lasted for the duration of the war. In 1943, 800 applicants competed for 200 positions in a special six-month Inter-American Institute of Meteorology held in Medellín, Colombia. This institute made English into the lingua franca of Latin American meteorology: applicants had to pass an English exam and received intensive language instruction from four North American teachers for the duration of the course. Students from every Latin American republic attended this institute. Forty-six graduates with appropriate mathematical and language skills were then sent to the United States for nine months of advanced training alongside U.S. wartime recruits: three each to MIT,

---

26. Rossby (20 July 1940); Application (9 Dec. 1940); Bjerknes (22 Dec. 1940); Galmarini (1943); Weightman (1944).

27. Kaplan (2 Sept. 1941, 7 Oct. 1941, 20 Oct. 1941); Rossby (14 Oct. 1941, 22 Nov. 1941, [Nov. 1941]).

Chicago, NYU, and Cal Tech, six to Iowa State to study agricultural climatology, and the remaining 28 to study at UCLA. This distribution clearly shows the fingerprints of Rossby's plan to extend the Bergen School's influence, as well as the long-held belief among California boosters that their state was destined to be the metropolis for a Hispanic American empire.<sup>28</sup> Thirty-two members of this original class were assigned for three to four months to U.S. Weather Bureau offices where they learned the practical skills of public forecasting. Another seven went to Puerto Rico to a special School of Tropical Meteorology run by the University of Chicago. About half of the original 200 immediately received professional employment either with an airline or government weather service when they returned home—an important gauge of the demand for trained meteorologists in Latin America during the war. From 1944 to 1946, UCLA trained an additional 42 meteorologists from an overall total of 17 Latin American states.<sup>29</sup>

The United States' full mobilization for war after the bombardment of Pearl Harbor on 7 December 1941 prevented Rossby and Bjerknes from taking a South American tour. Instead, they got something better. The U.S. Weather Bureau brought an entire generation of Latin American meteorologists to study at Scandinavian outposts in North America. Practically all of the Latin American students who came to the United States received training from a program run by Bergen school meteorologists. Like their U.S. counterparts, these young scientists were explicitly selected for their mathematical abilities, which predisposed them to adopt the quantitative, physical approach to weather prediction long promoted by the Bergen school. Their English skills and foreign experience, meanwhile, often predisposed them to look to the United States for scientific leadership.<sup>30</sup>

It is difficult to evaluate the depth of training these students received in air mass analysis and other techniques associated with the Bergen school. Bjerknes, Rossby, and Pettersen were often assigned to other, more pressing matters during the later part of the war (such as the D-Day forecast), though they left dedicated disciples to teach in their place. The United States' wartime program for "Education and Training in Meteorology for the Armed Forces" intended to produce scientists with the ability to work

---

28. See Brechin (1999).

29. Weightman (1944); Sarle (14 Aug. 1942, 23 July 1943); Taylor (6 July 1944, 29 June 1945); Bjerknes (3 July 1944); Graduation (11 Oct. 1944); U.S. Weather Bureau (29 Oct. 1945).

30. See More (1960), p. 405-411.

anywhere in the world. But these Latin American scientists often went home to work for weather services where they lacked the resources—especially upper-air observations—that they needed in order to make proper operational use of their new forecasting skills. Technical training alone could not solve the dilemmas of “underdevelopment.”<sup>31</sup>

That said, this wartime trend furthered the development of “national” scientific capabilities throughout the Americas in dramatic fashion. It also extended the military, commercial, and cultural influence of the United States as it entered the Cold War. The Bergen school’s westward migration, meanwhile, converted Southern California into a global powerhouse for meteorology and oceanography, a classic case of the “moving metropolis” in imperial science.

The events of these years had other legacies. English has become the lingua franca of international meteorology and aviation. As imperial powers are wont to do, U.S. leaders lost interest in Latin America after the war—most notably by refusing to extend the Marshall Plan to its wartime allies to the South—as the United States became caught up in the East-West dynamics of the Cold War.<sup>32</sup> Following the precedent set by the “struggle for Latin American airways,” nationalist movements in Latin America enflamed by such neocolonial attitudes—notably revolutionary Cuba—sometimes expropriated U.S.-owned airlines in the name of “national security.” Ironically, Germans often led the expert missions later sent to repair the United States’ post-war neglect of Latin American meteorology.<sup>33</sup>

Jacob Bjerknes, however, never forgot his “California” connection to Latin America. In 1954, he made the first of several trips to South America as a meteorological consultant and researcher. Bjerknes’s place on the earth eventually led him to turn his attention to Peru’s El Niño phenomenon and to develop the “Walker Circulation” model of its large-scale features.<sup>34</sup> Thus, the geopolitical dynamics of the early 1940s ultimately influenced the basic content of environmental science.

---

<sup>31</sup> On the mediocre results obtained by German military missions to South America before World War I, see Sater and Herwig (1999). On the multiple dilemmas development experts faced in postwar Latin America, see Pinto and Sunkell (1966); Escobar (1995).

<sup>32</sup> This represents the virtual consensus of the post-“Consensus School” history of U.S.-Latin American relations; see Coerver and Hall (1999), p. 110-115; LaFeber (2002); Latham, (2000), p. 25-26, 72-76; Pike (1992), p. 273, 278; Benjamin (1987); Wood (1984).

<sup>33</sup> For example, see Rudloff (1959), a depressing account of the state of post-war meteorology in Peru; see also Miller (2001).

<sup>34</sup> El Dr. Jacobo Bjerknes (1954); for an extended treatment of these legacies, see Cushman (2004).

## 5 References

- Application** for Special Leave of Absence: Jacob Bjercknes, 9 Dec. 1940, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.
- Benjamin, J.R.**, 1987: The Framework of U.S. Relations with Latin America in the Twentieth Century. *Diplomatic History* 11, no. 2, 91-112.
- Bilstein, R.E.**, 2001: *The Enterprise of Flight: The American Aviation and Aerospace Industry*. Smithsonian Institution Press, Washington, DC.
- Bjercknes, J.**, 2 July 1940, Letter to Rossby, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.
- , 22 Aug. 1940, Letter to Kaplan, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.
- , 22 Dec. 1940, Letter to Headrick, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.
- , 3 July 1944, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 175/1.
- , 1 Feb. 1946, Letter to Sproul, Dept. of Meteorology, Office of Chancellor, Administrative Files, UCLA, file 223/19.
- Bowie, E.H.**, 1943: Latin American Section. *Bulletin of the American Meteorological Society*, 24, no. 1, 1-2.
- Brechin, G.**, 1999: *Imperial San Francisco: Urban Power, Earthly Ruin*. University of California Press, Berkeley and Los Angeles.
- Brooks, C.F.**, (1941): The Joint Meeting of the Eighth American Scientific Congress and the American Meteorological Society, Washington, D.C., May 14, 1940. *Bulletin of the American Meteorological Society*, 22, no. 2, 77-81;
- , 1942: A Supplement to This Issue of the Bulletin. *Bulletin of the American Meteorological Society*, 23, no. 10, 420.
- Burden, W.A.M.**, 1943: *The Struggle for Airways in Latin America*. Council on Foreign Relations, New York.
- Coerver, D.M., and L.B. Hall**, 1999: *Tangled Destinies: Latin America and the United States*. University of New Mexico Press, Albuquerque.
- Cushman, G.T.**, 2004: Choosing between Centers of Action: Instrument Buoy, El Niño, and Scientific Internationalism in the Pacific, 1957-1982. In: *The Machine in Neptune's Garden: Historical Perspectives on Technology and the Marine Environment*. H.M. Rozwadowski and D.K. van Keuren (eds.), Science History Publications, Sagamore Beach, MA, 133-182.
- Day, D.**, 1999: Bergen West: Or, How Four Scandinavian Geophysicists Found a Home in the New World. *Historisch-Meereskundliches Jahrbuch*, 6, 69-82.

**El Dr. Jacobo Bjerknæs**, famoso hombre de ciencia, realiza estudios para aumentar el área eléctrica y de riego del norte del país, 15 July 1954: Norte (Salta, Argentina), clipping in Jacob Bjerknæs papers, UCLA.

**Doty, E.A.**, 17 Mar. 1977, Letter to Myers, Jacob Bjerknæs papers, UCLA, file 1/5.

**Eighth American Scientific Congress**, 1941: Proceedings of the Eighth American Scientific Congress Held in Washington, May 10-18, 1940. Department of State, Washington, DC.

**Eliassen, A.**, n.d., Jacob Aall Bonnevie Bjerknæs: November 2, 1897-July 7, 1975, Jacob Bjerknæs papers, UCLA, file 1/6.

**Escobar, A.**, 1995: Encountering Development: The Making and Unmaking of the Third World. Princeton University Press, Princeton, NJ.

**Flohn, H.**, 1962: Ludwig Weickmann zum Gedächtnis. Beiträge zur Physik der Atmosphäre 35, no. 3/4, 141-144.

**Friedman, M.P.**, 2003: Nazis and Good Neighbors: The United States Campaign against the Germans of Latin America in World War II. Cambridge University Press, Cambridge.

**Friedman, R.M.**, 1989: Appropriating the Weather: Vilhelm Bjerknæs and the Construction of a Modern Meteorology. Cornell University Press, Ithaca, NY.

**Fuller, J.F.**, 1990: Thor's Legions: Weather Support to the U.S. Air Force and Army, 1937-1987. American Meteorological Society, Boston.

**Galmarini, A.G.**, 1943: Nuevos horizontes de la meteorología continental americana. Bulletin of the American Meteorological Society, 24, no. 1, 2-4.

-----, 1945: Dr. Walter Knoche, 1881-1945. Bulletin of the American Meteorological Society, 26, no. 7, 273.

**Georgii, W. and H. Seilkopf**, 1926: Ergebnisse einer flugwissenschaftlichen Forschungsreise nach Columbia (S.A.). Aus dem Archiv der Deutschen Seewarte, 43, no.3.

**Gilluly, J., et al.**, 27 Mar. 1940, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

**Graduation of Students in Class Seven of the War Training Program in Meteorology**, 3 June 1944, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 175/1.

**Gran enciclopedia argentina**, 1957: Ediar, Buenos Aires.

**Green, D.**, 1971: The Containment of Latin America: A History of the Myths and Realities of the Good Neighbor Policy. Quadrangle Books, Chicago.

**Holmboe, J.**, 24 June 1940, Letter to Bjerknes, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

-----, 10 July 1940, Letter to Kaplan, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

**Joint Meeting** of Royal Meteorological Society and American Meteorological Society, Toronto, Canada, August 28-29, 1939. *Bulletin of the American Meteorological Society*, 20, no. 6, 276.

**Kaplan, J.**, 2 Sept. 1941, 7 Oct. 1941, 20 Oct. 1941, Letters to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 108/14.

-----, 24 Feb. 1942, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 136/2.

-----, 4 Aug. 1943, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 156/9.

**Knudsen, V.O.**, 16 Jan. 1940, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

**Latorre T., O.**, 1999: *El hombre en las Islas Encantadas: La historia humana de Galápagos*. FUNDACYT, Quito.

**LaFeber, W.**, 2002: *America, Russia, and the Cold War, 1945-2000*, 9th ed. McGraw-Hill, Boston.

**Latham, M.E.**, 2000: *Modernization as Ideology: American Social Science and "Nation Building" in the Kennedy Era*. University of North Carolina Press, Chapel Hill.

**Lewis, J.M.**, 1994: *Cal Tech's Program in Meteorology: 1933-1948*. *Bulletin of the American Meteorological Society*, 75, no. 1, 69-82.

**Lotchin, R.W.**, 1992: *Fortress California, 1910-1961: From Warfare to Welfare*. Oxford University Press, New York.

**MacLeod, R.**, 1982: *On Visiting the 'Moving Metropolis': Reflections on the Architecture of Imperial Science*. *Historical Records of Australian Science*, 5, no. 3, 1-16.

-----, (ed.), 2000: *Nature and Empire: Science and the Colonial Enterprise*. *Osiris*, 2nd ser., vol. 15.

**Miller, C.A.**, 2001: *Scientific Internationalism in American Foreign Policy: The Case of Meteorology, 1947-1958*. In: *Changing the Atmosphere: Expert Knowledge and Environmental Governance*. C.A. Miller and P.N. Edwards (eds.), MIT Press, Cambridge, MA, 167-217.

**Morandi, L.**, 1943: *Algunas actividades meteorológicas en el Uruguay*. *Bulletin of the American Meteorological Society* 24, no. 9, 354-357.

**More, E.**, 1960: *Reportajes con radar*. Librería e Imprenta Minerva, Lima.

**Nebeker, F.**, 1995: *Calculating the Weather: Meteorology in the 20th Century*. Academic Press, San Diego.

**Nunn, F.M.**, 1983: *Yesterday's Soldiers: European Military Professionalism in South America, 1890-1940*. University of Nebraska Press, Lincoln.

**Pattillo, D.M.**, 1998: *Pushing the Envelope: The American Aircraft Industry*. University of Michigan Press, Ann Arbor.

**Petterssen, S.**, 2001: *Weathering the Storm: Sverre Petterssen, the D-Day Forecast, and the Rise of Modern Meteorology*. James Rodger Fleming (ed.). American Meteorological Society, Boston.

**Pike, F.B.**, 1992: *The United States and Latin America: Myths and Stereotypes of Civilization and Nature*. University of Texas Press, Austin.

-----, 1995: *FDR's Good Neighbor Policy: Sixty Years of Generally Gentle Chaos*. University of Texas Press, Austin.

**Pinto, A., and O. Sunkell**, 1966: Latin American Economists in the United States. *Economic Development and Cultural Change* 15, no. 1, 79-86.

**Platt, D.C.M.** (ed.), 1977: *Business Imperialism, 1840-1930: An Inquiry Based on British Experience in Latin America*. Clarendon Press, Oxford.

**Reichelderfer, F.W.**, 1943: Report of the Chief of the U. S. Weather Bureau 1942. *Bulletin of the American Meteorological Society*, 24, no. 3, 103-110.

**Rinke, S.H.**, 1995: Die Firma Junkers auf dem lateinamerikanischen Markt, 1919-1926. In: *Grenzenlose Märkte?: Die deutsch-lateinamerikanischen Wirtschaftsbeziehungen vom Zeitalter des Imperialismus bis zur Weltwirtschaftskrise*. Boris Barth and Jochen Meissner (eds.), Lit Verlag, Münster.

-----, 1996: "Der letzte freie Kontinent": Deutsche Lateinamerikapolitik im Zeichen transnationaler Beziehungen, 1918-1933, 2 vol. Heinz, Stuttgart.

**Rossby, C.G.**, 7 Mar. 1940, Letter to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

-----, 20 July 1940, Letter to Bjerknes, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

-----, 14 Oct. 1941, 22 Nov. 1941, Letters to Sproul, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 108/14.

-----, [Nov. 1941], Letter to Benton, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 108/14.

**Rudloff, W.H.B.**, 1959: *Meteorology in Peru*, United Nations Technical Assistance Programme report no. TAA/PER/8. New York.

**Sarle, C.F.**, 14 Aug. 1942, Letter to Kaplan, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 136/2.

-----, 23 July 1943, Memorandum to the Universities Teaching Professional Meteorology, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 156/9.

**Sater, F., and H. H. Herwig**, 1999: *The Grand Illusion: The Prussianization of the Chilean Army*. University of Nebraska Press, Lincoln.

**Scripps Institution of Oceanography**, [1945], Report to Regents of the University of California, Scripps Institution of Oceanography, General Matters, Office of Chancellor, Administrative Files, UCLA, file 87/18.

**Sproul, R.G.**, Aug. 1940, Letter to Holmboe, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

**Taylor, G.F.**, 6 July 1944, Letter to Corley, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 175/1.

-----, 29 June 1945, Letter to Bjerknes, Dept. of Meteorology, Office of Chancellor, Administrative Files, UCLA, file 193/12.

**Thomas, M.K.**, 1994: The Formation and Early Days of the Canadian Branch of the Royal Meteorological Society. *CMOS Bulletin SCMO* 22, no. 1, 7-13.

**Topik, S.C., and A. Wells (eds.)**, 1998: *The Second Conquest of Latin America: Coffee, Henequen, and Oil during the Export Boom, 1850-1930*. University of Texas Press, Austin.

**United States Weather Bureau**, 29 Oct. 1945, Contract for University Training in Meteorology, Dept. of Meteorology, Office of Chancellor, Administrative Files, UCLA, file 193/12.

**Varney, B.M.**, 16 Jan. 1940, Letter to Knudson, Dept. of Physics, Meteorology Program, Office of Chancellor, Administrative Files, UCLA, file 84/1.

**Wagner, W.**, 1996: *Hugo Junkers: Pioneer der Luftfahrt - seine Flugzeuge*. Bernard und Graefe Verlag, Bonn.

**Weglyn, M.**, 1976: *Years of Infamy: The Untold Story of America's Concentration Camps*. Morrow Quill, New York.

**Weightman, R.H.**, 1944: Meteorological Training for Latin-American Students. *Bulletin of the American Meteorological Society*, 25, no. 4, 435-436.

**Wood, B.**, 1984: *The Unmaking of the Good Neighbor Policy*. University of Texas Press, Austin.

ALGORISMUS

STUDIEN ZUR GESCHICHTE DER MATHEMATIK  
UND DER NATURWISSENSCHAFTEN  
HERAUSGEGEBEN VON MENSIO FOLKERTS

Heft 52

ERV DR. ERWIN RAUNER VERLAG  
AUGSBURG 2005

## **From Beaufort to Bjerknes and Beyond**

Critical Perspectives on Observing, Analyzing, and Predicting Weather and  
Climate

A collection of nineteen essays evolving from a conference of the  
International Commission on History of Meteorology (ICHM)  
held in the Baroque Library of Kloster Polling, Germany, July 5-10, 2004

edited by

Stefan Emeis and Cornelia Lüdecke

ERV DR. ERWIN RAUNER VERLAG  
AUGSBURG 2005